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# MATHEMATICS

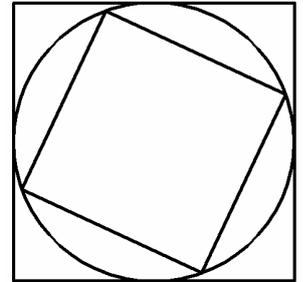
## SHORT ANSWER PROBLEMS

### IMSO 2007

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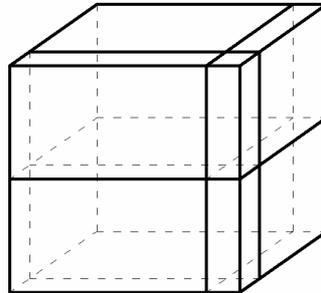
1. If 672 is divided into three parts proportional to 3, 4 and 5, what is the largest number?
2. Anelka's weight is a whole number. If Anelka gains 6 kilograms, his weight will be less than 36 kilograms. If he gains 8 kilograms, his weight will be more than 36 kilograms. What is Anelka's weight?

3. In the figure, a circle is inscribed in the larger square. The four vertices of the smaller square are on the circle. The area of the larger square is  $49 \text{ cm}^2$ . What is the area of the smaller square?

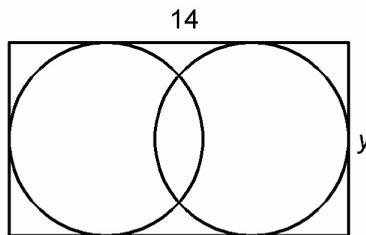


4. Initially, two elevators were at the same floor. The first elevator went up 4 floors and then went down 7 floors. The second elevator went up 11 floors and then went down 9 floors. After the movements, how many floors apart were the two elevators?
5. Use each of the digits 1, 2, 3, 4, 5 and 6 exactly once to form two 3-digit numbers. What is the largest possible product of the two 3-digit numbers?
6. In the expression  $\frac{a}{b} + \frac{c}{d} + \frac{e}{f}$ , each letter is replaced by a different digit among 1, 2, 3, 4, 5, and 6. What is the smallest possible value of this expression?
7. Some cats and some pigeons are in the pigeon loft. The total number of their heads is 34 and the total number of their legs is 80. How many cats are there?

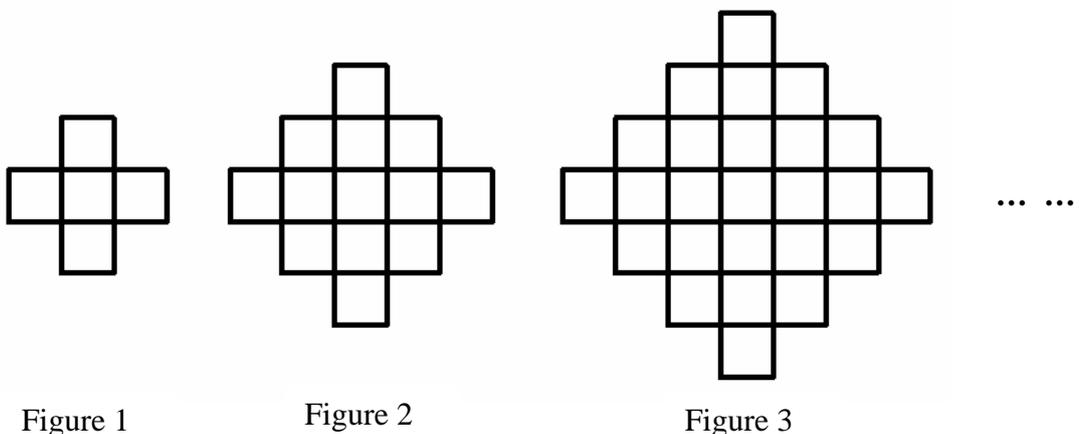
8. A 10 cm x 10 cm x 10 cm cube is cut parallel to its three faces as shown in the figure. After cutting, eight smaller solids are formed. What is the total surface area of these smaller solids?



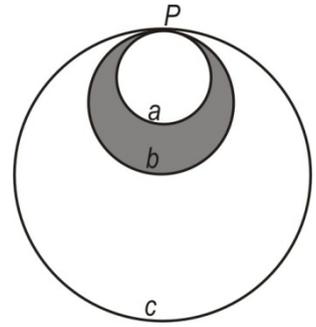
9. What is the largest 2-digit prime number that can be obtained by adding two prime numbers?
10. In the figure, two equivalent circles are placed in the rectangle. The distance between the two center points of the circles is  $\frac{3}{4}y$ . What is the value of  $y$ ?



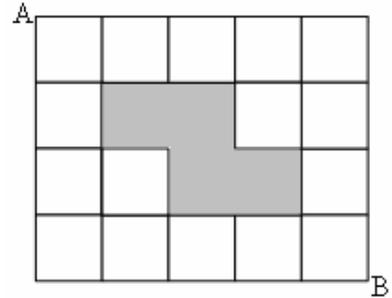
11. Sixteen matchsticks are used to construct Figure 1, thirty-six matchsticks for Figure 2, and so on. With this gradual increase (the middle row of Figure  $n$  contains  $2n+1$  squares), how many matchsticks are needed to construct the Figure 10?



12. In the figure, three circles  $a$ ,  $b$  and  $c$  touch at the point  $P$ . The center of circle  $c$  is on circle  $b$ , and the center of circle  $b$  is on circle  $a$ . What is the ratio of the shaded area to the unshaded area of circle  $c$ ?

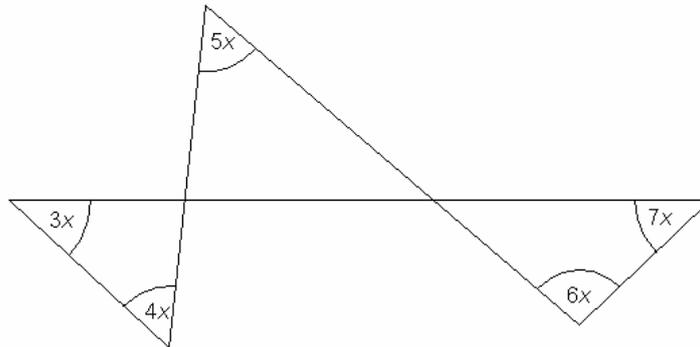


13. In the following grid, how many shortest paths are there to travel from A to B?



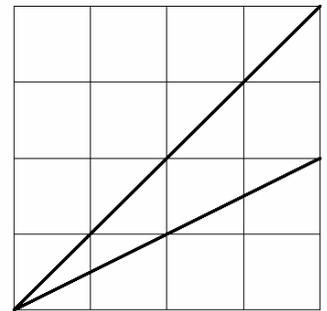
14. Mary has six \$0.1 stamps, five \$0.4 stamps, four \$0.5 stamps, three \$5 stamps, and two \$10 stamps. She is going to send a parcel by mail and the mailing fee required is \$38.1. At most how many stamps remain after mailing?
15. Tony is drawing some triangles and their side lengths are whole numbers. Each triangle has a perimeter of 7 units. At most how many triangles of different sizes can Tony draw?
16. The average of the squares of seven consecutive integers is 629. What is the smallest integer?
17. Some people are waiting in a queue. Abel is exactly in the middle of the queue. Sarah is number 14 and she is somewhere behind Abel. Bart is number 20. At most how many people can be in the queue?

18. In the figure below, what is the value of  $x$ , in degrees?



19. Given  $a \Delta b = (a - b)(a + b)$  and  $c \otimes d = d^2 - \frac{1}{30}c$ . What is the value of  $(10 \Delta 5) \otimes 3$ ?

20. In the figure, the diagonal of a  $4 \times 4$  square passes through 5 corner points of the small squares. The diagonal of a  $4 \times 2$  rectangle passes through 3 corner points of the small squares. In how many corner points of the small squares will one diagonal of a  $45 \times 60$  rectangle pass through?



21. Sisca counts from 1 using her left hand fingers starting from thumb, index finger, middle finger, ring finger, little finger, ring finger, middle finger, index finger, thumb, and then index finger again, and so on. Which finger will be on the 2007<sup>th</sup> count?

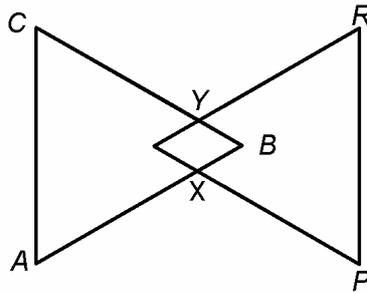
22. Euis has a list of all 4-digit natural numbers. Each number satisfies the following four conditions:

- All digits are different.
- No digit is 0, 5, 7 or 9.
- The sum of the four digits is 20.
- It is divisible by 4.

How many numbers are there in the list?

23. Adi writes the number 1234567891011121314 ... 99100101102 ... 996997998999 by first writing the numbers 1, 2, 3, ..., 996, 997, 998, 999, then removing all the commas. What is the 2007<sup>th</sup> digit counting from the right?

24. In the figure below,  $ABC$  and  $PQR$  are two equilateral triangles of area 1 unit each. If  $CY = AX = 2YB = 2XB$  and  $RY = PX = 2YQ = 2QX$ , what is the area of  $ACYRPX$ ?



25. A number is called *palindrome* if it reads the same from the left and from the right. For example, 130031 is a palindrome. Writing all palindromes in order we get 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 22, 33.... What is the 2007<sup>th</sup> palindrome?